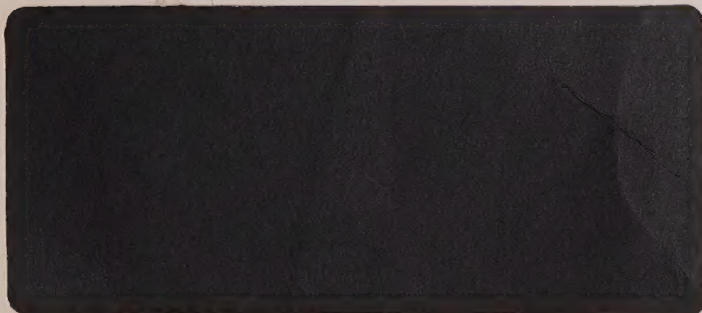


MODEL 2100
WAVE ANALYZER



CAL LAB
2.5754

OFFICIAL RECORDS STATION
FILE COPY
FACILITIES

**ADVANCED
INSTRUMENTATION**

**DONNER SCIENTIFIC
COMPANY**



DONNER SCIENTIFIC COMPANY

WARRANTY

RETURN TO
201
TEST EQUIPMENT STORE
COPY NO.

Donner instruments are warranted during a period of one year from date of shipment to original purchaser to be free from defects in material and workmanship. This warranty does not apply to vacuum tubes, except as they are warranted by tube manufacturers. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by Buyer at his expense during such period and which has not been subjected to misuse, neglect, improper installations, repair, alteration, or accident. Seller shall have the right of final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warranty is in lieu of any other warranty, express, implied or statutory, and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

RECEIVING INSPECTION

Every Donner instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way or fails to operate, a claim should immediately be filed with the transportation company.

REPAIRS

Whenever a Donner instrument requires service, the nearest Donner representative should be contacted; all representatives will provide immediate service or arrange factory returns when necessary.

Please specify both model and serial number in all correspondence concerning Donner instruments. Address all inquiries on operation or applications of Donner instruments to your nearest sales representative or Sales Manager, Donner Scientific Company, 888 Galindo Street, Concord, California.



SUITE 123-124 • NUMBER 2 HANFORD STREET
SEATTLE 4, WASH. • MAIN 4-5135

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DONNER MODEL 2100

WAVE ANALYZER

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GENERAL DESCRIPTION

The Donner Model 2100 Wave Analyzer is a heterodyne-type, frequency-selective vacuum-tube voltmeter designed to measure accurately the relative amplitudes and frequencies of spectrum components of an input signal. Accurate readings are obtainable over the frequency range 30 to 50,000 cps. Two half-lattice crystal filters are used, with either narrow or broad selectivity as controlled by a front-panel switch. This instrument has been designed for versatility and portability, together with simplicity and ease of operation.

SPECIFICATIONS

Frequency Range:	30 to 50,000 cps, continuously adjustable.
Frequency Calibration:	Accurate within 3% $\pm$ 10 cps at any setting.
Input Frequency Dial:	16-inch scale length, expanded at low-frequency end.
Frequency Selectivity:	(Half-band width): Narrow: 9 cps at 3 db down, 40 cps at 40 db down. Broad: 20 cps at 3 db down, 125 cps at 40 db down. (Narrow is flat-topped; broad is round-topped).
Input Voltage Range:	Full-scale meter indication with signals 500 volts to 160 microvolts rms. Reference levels between 500 volts and 50 millivolts may be set on the meter to 100% (0 db) by the input attenuators, with the meter range switch at the 100% (0 db) position. The latter then moves in five 10-decibel steps to increase sensitivity for full-scale readings down to 0.3% (-50 db). The lowest usable reading is approximately 0.02% (-70 db).
Voltage Calibration:	Accurate within 5% of full scale.
Residual Distortion:	65 to 75 decibels below 100% (0 db) level.
Hum and Noise:	Approximately 70 decibels below 100% (0 db) level.
Input Impedance:	200,000 ohms.
Power Requirement:	115 volts ($\pm$ 15%), 50-60 cps, 45 watts.

Dimensions: Cabinet 14-3/4 wide x 9-1/4 high x 9-1/8 inches deep.
Rack-mounting version on standard 8 3/4 x 19 inch panel.

Weight: 23 pounds (net); 28 pounds (shipping).

CIRCUIT DESCRIPTION

Figure 1 shows a functional block diagram of the instrument. The amplitude of the input signal which is to be analyzed is set to the reference level by the input attenuators and is fed to the input cathode follower. This cathode follower isolates the input circuit from the rest of the instrument and provides the necessary impedance transformation to feed the input signal to the balanced modulator. A tunable local oscillator, whose frequency is controlled by the main tuning dial, operates below the IF frequency of 395 KC so that the sum of the desired frequency component of the input signal and the local oscillator frequency is always equal to the IF frequency. Thus, the signal component being measured has its frequency transformed to the IF frequency and is amplified and measured at this fixed frequency. Other frequency components present in the input signal transform to other frequencies, which are rejected by the two half-lattice crystal filters. The local oscillator is of the series-tuned type and has its main frequency-determining elements located in a special compartment for isolation from outside disturbances.

A Type 6AL5 double diode is connected as a series-balanced modulator. Local oscillator signal is coupled to the two diodes through transformer T103. These diodes modulate the input signal current flowing from V101-A through T102, at the local oscillator frequency. Sum and difference frequencies appear at the secondary terminals, the local oscillator signal being balanced out. The input signal itself is too low in frequency to develop any appreciable voltage at the secondary of T102.

The upper sideband or sum frequency falling at 395 KC passes through Crystal Filter Number 1 to the meter range switch. This switch may be moved in 10 db steps, successively increasing the sensitivity of the instrument to a maximum full-scale sensitivity of -50 db or 0.3% of the reference level. The signal from the meter range switch is amplified by the first IF amplifier stage and then passes through Crystal Filter Number 2, which, being identical to Crystal Filter Number 1, doubles the overall selectivity. Further amplification is provided by the second IF amplifier, the output of which goes to the metering circuits. An amplifier-rectifier type of vacuum-tube voltmeter indicates the resultant

signal level on a 4-1/2 inch square panel meter. Two resistance-coupled amplifier stages having approximately 36 db of negative current feedback from the meter movement are used to insure linearity and accuracy of the metering circuit. Plate supply voltage for all tubes is regulated by a Type OA2 voltage regulator tube, to minimize the effects of supply line voltage variations.

INSTALLATION

No special installation is necessary for the Donner Model 2100, beyond connecting the AC line cord to a proper power source and strapping the power transformer primary for the voltage used. Sufficient clearance should be allowed between the instrument and adjacent equipment to assure adequate ventilation. It should be kept in mind when connecting a signal to the input terminals that this is a high gain, high input impedance instrument; care should be used in locating, grounding, and shielding input leads to avoid picking up stray fields and hum voltages.

OPERATION

To place the Donner Model 2100 in operation, set the METER RANGE switch to the SET LEVEL position, turn the power switch ON, and allow at least fifteen minutes for warm-up.

With no input signal applied, set the main tuning dial to ZERO and the FINE TUNING knob to the index mark on the panel. Carefully rotate the CALIBRATE knob until maximum indication is obtained on the meter. This procedure adjusts the frequency of the local oscillator to 395 KC, so that the tuning dial calibration will read correctly the frequency of input signal components under measurement.

Next, carefully rotate the BALANCE control knob for a minimum reading; this adjusts the modulator to balance-out the local oscillator signal. Readjust the CALIBRATE knob slightly, for a maximum reading. The minimum reading thus obtained, when the local oscillator frequency is tuned to the IF frequency and the modulator is balanced, should be well below the INPUT LEVEL mark on the meter when the METER RANGE switch is in the SET LEVEL position. This balancing operation nulls out the local oscillator signal appearing in the balanced modulator output, so that this carrier signal will not interfere with the measurement of low frequencies or tend to overload the crystal filters or the IF amplifier stages. The small residual reading is due to minute fluctuations in power line voltage and frequency.

After the procedures of calibration and balancing have been carried out as described above, the instrument is ready to measure the spectrum components of input signals. With a signal applied to the input terminals,

tune the instrument over its entire frequency range to find the input signal component having the largest amplitude; this is usually the fundamental if a single source of signal is present, but it may be of any frequency if measurements are being made of intermodulation distortion or of a multi-channel carrier system. The FINE TUNING control should be adjusted to maximize the meter reading.

While tuned to the largest amplitude component and with the METER RANGE switch in the SET LEVEL position, adjust the input level attenuators so that the panel meter reading corresponds to the INPUT LEVEL mark. Now turn the METER RANGE switch to the 100% (0 db) position and adjust the FINE input attenuator as necessary for precisely 100% indication; this signal level now becomes the 100% or zero db reference level, so long as the input attenuators are not disturbed. The main tuning dial and FINE TUNING Control may now be adjusted to select the other signal components for measurement of their frequencies and relative amplitudes. For these measurements, the METER RANGE switch should be set so that the meter reading at resonance falls between 0 db and -10 db. Percentage readings may be read directly on the appropriate meter scale and db readings will be the sum of the markings on the meter scale and the METER RANGE switch.

Either the NARROW or the BROAD position of the CRYSTAL SELECTIVITY switch may be used. The BROAD position is advantageous when tuning rapidly over the spectrum or when the signals have a small amount of frequency instability, such as those from the reproduction of a recording. The NARROW selectivity position is preferred for improved measurement accuracy when signal components are spaced relatively close together.

If it is desired to use the instrument as a direct-reading selective voltmeter, a reference signal level corresponding to a known voltage may be used to establish the gain of the instrument. This is done by tuning the wave analyzer to resonance with a sine-wave signal source of known amplitude, such as an audio oscillator or a 60 cps filament supply. The input attenuators are then adjusted so that the meter reading bears a convenient ratio to the known signal voltage. For example, 60% might correspond to 6 volts rms. The instrument would then be operated in the normal manner with the chosen ratio applying to all readings, provided that the input attenuators were not disturbed. Care should be taken to avoid overloading the balanced modulator stage with signals exceeding the 100% level. The effect of such overloading would be to exceed the linear operating range of the modulator, generating non-linear distortion products.

MAINTENANCE

Except for renewal of the fuse, pilot light or tubes, servicing should be referred to the nearest Donner Scientific Company representative. A circuit diagram of the Donner Model 2100 is included with this manual for reference purposes. To remove the instrument from its case, place the instrument on its face and remove the four screws holding the back panel in place. Remove the back panel, then slide the cabinet shell off

the instrument. Tubes, wiring and adjustments will now be completely accessible.

If the Type 6AL5 tube is replaced, it may be necessary to readjust C 121 in order to balance properly the modulator from the front panel. This is done as follows. Turn the SELECTIVITY switch to the BROAD position and the METER MULTIPLIER switch to SET LEVEL. Adjust the CALIBRATE control for maximum meter reading with the main tuning dial set at zero. Adjust the BALANCE control R 139 alternately with C 121 for minimum reading. Repeat these adjustments of CALIBRATE, BALANCE, and C 121 several times until a sharply defined minimum, well below the INPUT LEVEL mark on the meter, is obtained.

ALIGNMENT PROCEDURE

In the event that it is necessary to re-align the instrument electrically, the following procedure should be carefully followed after the instrument is thoroughly warmed up.

With the CALIBRATE capacitor (C125) plates half meshed, the main tuning dial set to zero, and the FINE TUNING knob set to the panel index mark, carefully adjust C 128 for maximum meter deflection. The CALIBRATE control will then have the proper range for "zeroing" the local oscillator frequency.

NOTE: Do not do any of the adjustments in the following 3 paragraphs.
Carefully adjust the tuning slug of oscillator transformer T 103 for maximum bias voltage on pins 5 and 7 of V 104, which is the Type 6AL5 balanced modulator. This bias voltage should be approximately two volts.

Next, carefully adjust the tuning slug on modulator transformer T 102 for maximum meter indication. The IF peaking coils L 103 and L 105 may now be adjusted for maximum meter reading. This procedure will result in an approximate alignment by use of the local oscillator signal.

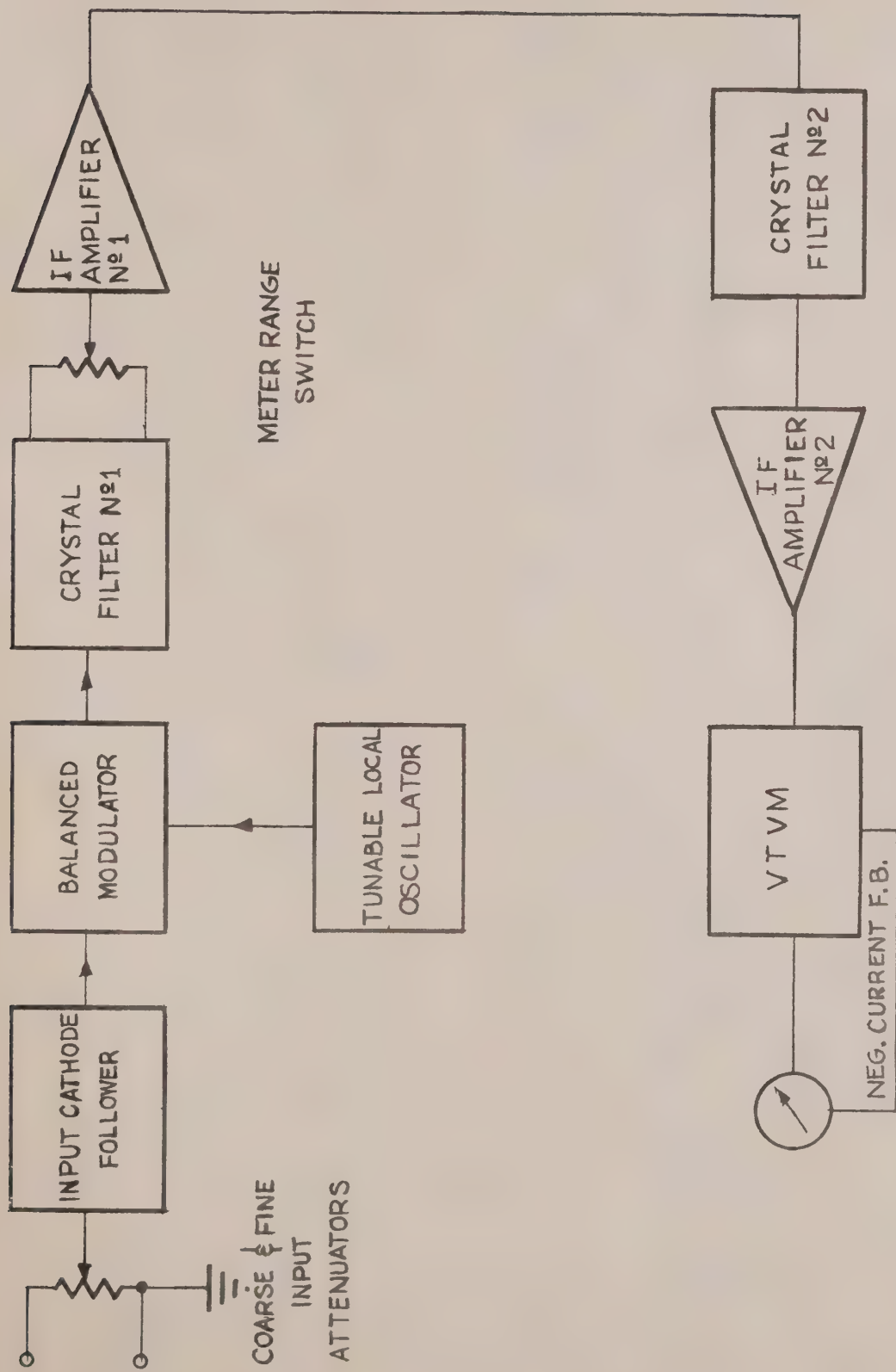
For a final, more precise alignment the following steps should next be followed: Balance the instrument in accordance with the instructions given in the second and third paragraphs under "OPERATION". With the SELECTIVITY switch in the BROAD position, feed a signal of approximately 1000 cps to the input terminals and tune the instrument to the fundamental component of this signal. Adjust the input attenuator so that the meter reads approximately half-scale with the METER RANGE switch in the SET LEVEL position. Next set the alignment adjustments

for maximum meter reading in the following order: L 105, L 103, T 102, L 102, L 104. The adjustment of L 102 and L 104 is very broad and it is usually sufficient to set the tuning slugs at the mid-points of their ranges.

OK to do these last 2 paragraphs

R 125 may be set by first tuning the instrument to resonance with a stable incoming signal, with the SELECTIVITY switch in the BROAD position, and noting the meter reading. Now turn the SELECTIVITY switch to the NARROW position and again tune to resonance. Adjust R 125 to obtain the same meter reading as before. This procedure adjusts the gain of the instrument with NARROW selectivity to the same value as the gain in the BROAD selectivity position.

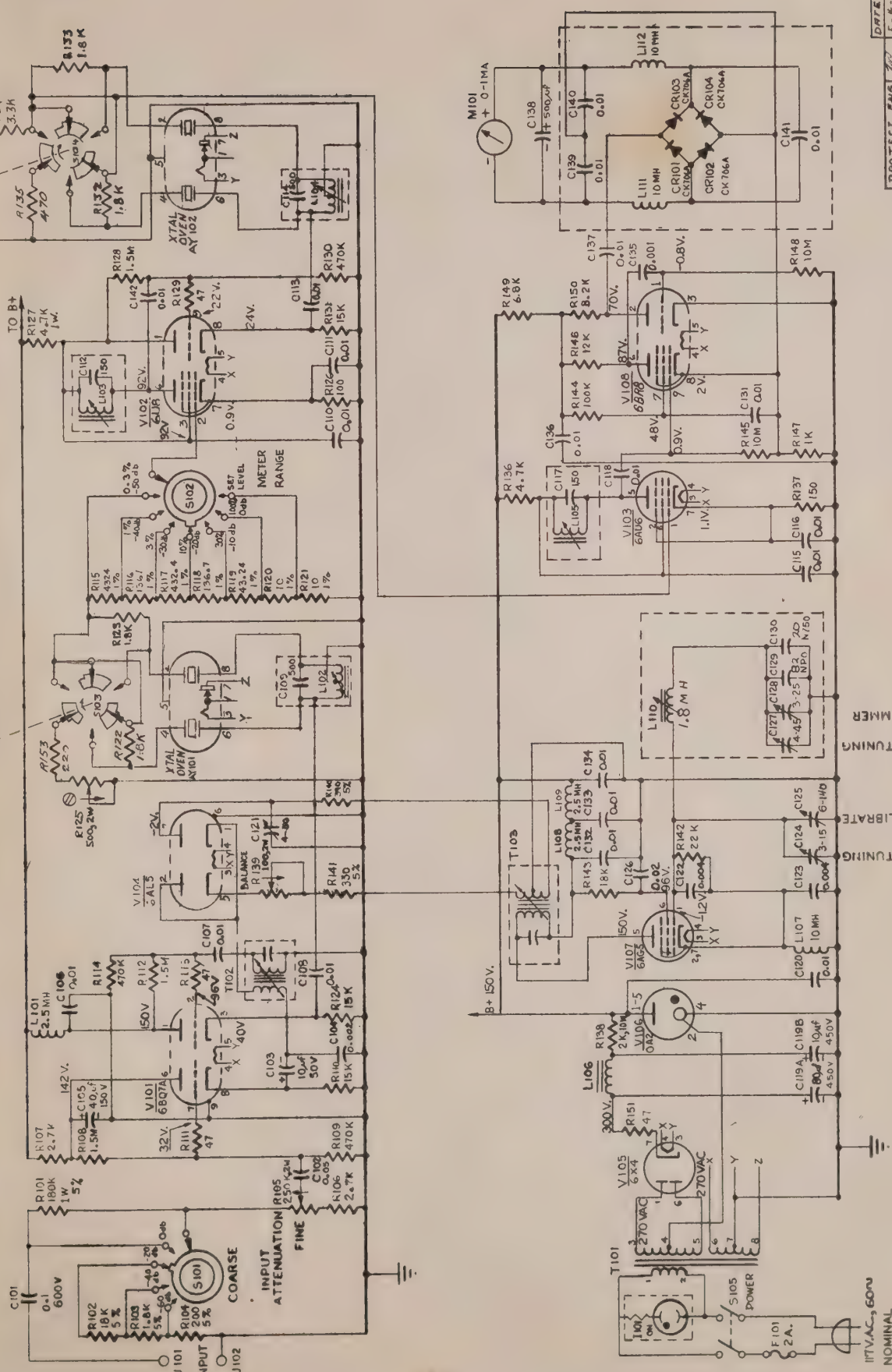
As a final check on the operation of the instrument, a measurement should be made of the minimum input signal level which will produce a reading of 100% or zero db, which is the input reference level. If more than 0.05 volt rms is required to reach this level with both input attenuators at their maximum clockwise position, a loss of gain is indicated; this is probably due to defective tubes or need for electrical alignment.



FUNCTIONAL BLOCK DIAGRAM OF MODEL 21 WAVE ANALYZER
FIGURE 1

CHANCE C126 TO -02 MED.	153	F	8/18/56	654
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SELECTIVITY SWITCH - SHOW: IN BROAD POSITION



TRIMMER
MAIN TUNING
CALIBRATE
FINE TUNING

2. CAPACITANCE VALUES ONLY $\pm 10\%$ TYP; LEAST THAN 10% TYP.
 1. RESISTANCE IN OHMS; RESISTANCE TYP $\pm 10\%$.
 NOTES: UNLESS OTHERWISE SPECIFIED.

UNLESS SPECIFIED DIMENSIONS IN INCHES		ITEM		DFT. NO.		TITLE	
TOLERANCES:		FRACTIONAL ± 1/64		± "		± "	
DECIMAL ± .005		ANGULAR		± "		± "	
DRAWN R.M.		CHECKED <i>[Signature]</i>		SCALE: 1" = 10"		PART OF: 1651	
DATE NOV. 55		APPROVED <i>[Signature]</i>		MOOD		MOOD	
PROJECT ENG 72		SIZE & MATERIAL OR DWG. NO.		SPEC. NO.		QTY.	
DRAWING NO.		970		ISSUE		6	
SCIENTIFIC COMPANY		DONNER		SCHEMATIC - ANALYZER		2100	
DATE 5-6-50		PROJECT ENG 72		DRAWING NO.		ISSUE	

**ADVANCED
INSTRUMENTATION**

ANALOG COMPUTERS

SERVO ACCELEROMETERS

TEST INSTRUMENTS

DONNER SCIENTIFIC
COMPANY

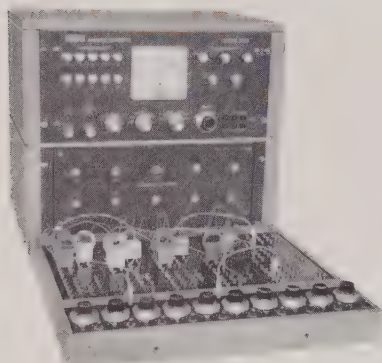
CONDENSED CATALOG

June 1958

ANALOG COMPUTING EQUIPMENT

Donner manufactures three models of analog computers for use as basic engineering and scientific tools of design, research, control, and instruction. They solve problems expressed as differential equations or transfer functions, simulate systems and processes, and function as control elements in systems.

NEW MODEL 3400 ANALOG COMPUTER WITH CHOPPER STABILIZED AMPLIFIERS (Shown with Model 3430 Problem Board)



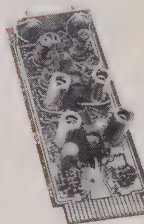
- 10 Chopper Stabilized wide-band dc operational amplifiers, output — 100 to + 100 volts, 13 ma.
 - 0.1% or 1.0% passive components. Single or 10 turn coefficient potentiometers.
 - Built-in controls, including Compute, Reset, and Hold.
 - Repetitive or continuous operation.
 - Integral meter for set-up, readout, and performance checking. Includes 0.1% null voltmeter.
 - Reference power supply for 5 initial conditions and bias voltages.
 - 2 thermionic diodes (floating), for limiting functions.
 - All problem connections are available on the problem board.
- Two or more Model 3400 Analog Computers can be slaved together and operated from any one computer.
 - May be operated with Donner auxiliary equipment listed on opposite page.

Model 3400,

MODEL 3430 REMOVABLE PROBLEM BOARD

Push-connects to Model 3400 Analog Computer, carrying entire problem; several may be used interchangeably. Provides all connections to amplifiers, diodes, relays, 6 trunk lines, 2 multiplier channels and 1 function generator.

Model 3430,



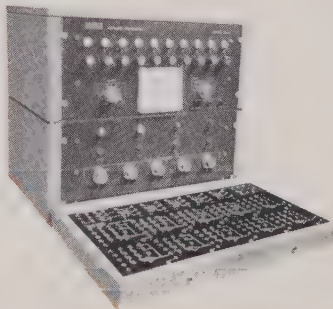
MODEL 3101 PLUG-IN AMPLIFIER

An integral part of the Model 3400, dc gain in excess of 50 million; maximum offset of a unity inverter, less than 200 $\mu\text{V}/\text{day}$; drift of unity integrator, less than 100 $\mu\text{V}/\text{sec}$; phase shift of unity inverter, less than 0.5 degrees at 1 kc. Amplifiers available separately.

MODULAR DESIGN

Versatility of the basic computer is easily increased by adding accessories in building-block manner. Each simply plugs in, without modification, and is supplied with one standard Donner cabinet module (2 sides, back, spacer), which bolts in place.

Castered floor-mounting bases and shelf unit (problem board support) are available for larger computing facilities. Two or more computers may be operated together to expand problem-handling capacity and flexibility.



MODEL 3000 DESK-TOP COMPUTER (Shown with Model 3034 Problem Board)

A basic engineering tool, used for design, research, and instruction. Solves many problems, expressed as differential equations or transfer functions. Complete dc analog computer, with all power supplies.

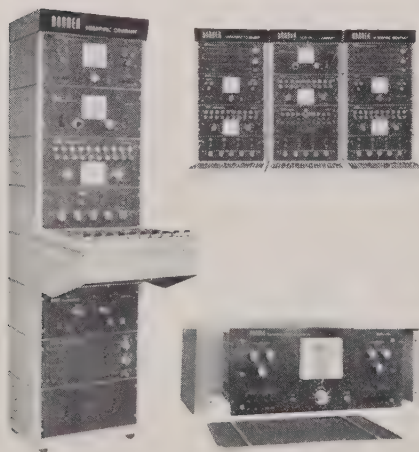
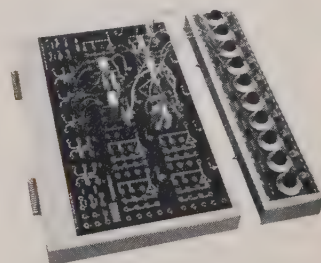
- 10 operational amplifiers, output —100 to +100 volts, 5 ma.
- 5 initial condition supplies, 0 to ± 100 volts, 5 ma.
- 2 thermionic diodes (floating), for limiting functions.
- Built-in controls, including Compute, Reset, and Hold.
- Integral meter for set-up, readout and performance checking.

Model 3000,

MODEL 3034 DETACHABLE PROBLEM BOARD (Shown with Model 3073 Potentiometer Strip)

Push-connects to Model 3000 Computer, carrying entire problem; several may be used interchangeably. Provides all connections to amplifiers, diodes, relays, and two accessories. Utilizes Donner plug-in precision components.

Model 3034,





MODEL 3100 ANALOG COMPUTER

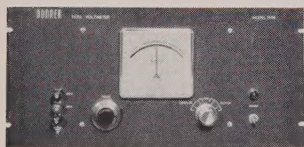
- A Complete Linear Computer
- 10 to 40 Chopper Stabilized Amplifiers
- 15 Initial Condition Potentiometers
- 20 to 40 Coefficient Potentiometers
- 0.1% Temperature-controlled Passive Components
- Latching Overload Lights
- Built-in Auxiliary Simulation Problem Board

The Donner Model 3100, designed for industry, research laboratories and educational institutions, is a highly accurate and versatile medium-sized computer console. Flexibility is achieved by using plug-in dual stabilized amplifiers and plug-in modules of coefficient potentiometers. Accuracy is maintained by employing high quality 0.1% polystyrene capacitors and 0.1% resistors in a temperature-controlled environment. Operational amplifiers have a dc gain in excess of 5×10^7 . When connected as a unity inverter, the maximum offset is less than 200 microvolts and the phase shift at 1000 cps is less than 0.2° . The removable AMP problem board accommodates non-linear equipment (see below) and has 70 additional trunk lines available for other computing components, or for interconnection between computers used in multiple.

Model 3100

10 Amplifiers and 35 Potentiometers,
30 Amplifiers and 55 Potentiometers,

AUXILIARY EQUIPMENT



MODEL 5000 NULL VOLTMETER

Compares applied voltage (or coefficient in computer problem) with internal standard, nulling with precision divider. Reads directly in range -100 to $+100$ volts with 0.1% accuracy. Serves also as precision voltage reference, -100 to $+100$ volts at 10 ma maximum, 0.05% regulation. Optional extra for Model 3000 only; integral part of Models 3100 and 3400.

With Standard Module, Model 5000,

Rack Mounting, Model 5000R,



MODEL 3720 CYCLIC RESET GENERATOR

(For Repetitive Computation)

Resets and restarts computer at end of computing period (adjustable smoothly from 0.05 to 16 seconds). Furnishes synchronized oscilloscope sweep trigger, advanced in proportion to solution time to insure display from start. Power supply built-in. Optional extra for Model 3000 only; integral part of Models 3100 and 3400.

With Standard Module, Model 3720,

Rack Mounting, Model 3720R,

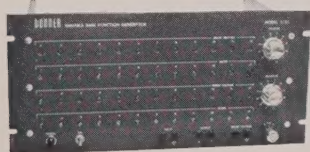


MODEL 3731 ELECTRONIC FUNCTION MULTIPLIER

Two separate channels (with common power supply) accept independently varying inputs U, V, X, and Y in range -100 to $+100$ volts, deliver products -0.01 UV and -0.01 XY. Four-quadrant multiplication or two-quadrant division.

With Standard Module, Model 3731,

Rack Mounting, Model 3731R,

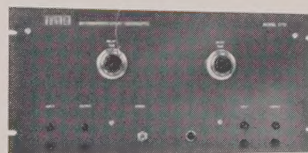


MODEL 3750 VARIABLE BASE FUNCTION GENERATOR

24-line segments may be adjusted to approximate almost any single-valued function. Generates powers, roots, empirical curves with inputs -100 to $+100$ volts. Integral power supply.

With Standard Module, Model 3750,

Rack Mounting, Model 3750R,



MODEL 3770 TRANSPORT DELAY GENERATOR

Self-contained unit furnishes two channels of adjustable transportation delay. Standard range of delay 0.5 to 10 seconds. Other ranges available are 0.005 to 0.1 and 0.05 to 1.0 seconds. Input and output range -100 to $+100$ volts. Used for accurate delay simulation in process and reactor control studies.

With Standard Module, Model 3770,
Rack Mounting, Model 3770R,

Any accessory shown available with complete cabinet and fan, if necessary, for

extra.

LINEAR SERVO ACCELEROMETERS

STANDARD VACUUM TUBE MODELS

All Donner models (see table below), ruggedized and hermetically sealed, are adaptable to any acceleration measuring problem. They are built to withstand changes in calibration or zero shift resulting from high overloads, and because of their servo construction they inherently have a fast recovery time. Donner units are well suited to airborne applications such as telemetering, navigation, control and guidance systems. In a typical application, the Model 4143 exercises a control function in the inertial stabilization of helicopters.



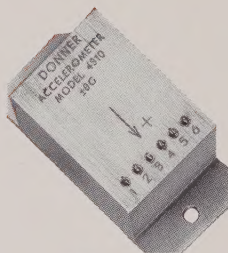
MODEL
4005



MODEL
4112



MODEL
4143



Half
actual
size

MODEL 4310 TRANSISTORIZED LINEAR SERVO ACCELEROMETER

- NON-LINEARITY PLUS HYSTERESIS — Within 0.05% deviation from best fitted straight line.
- STANDARD RANGES — Between ± 0.1 g full range and ± 30 g full range. Lower and higher ranges available on special order.
- RESOLUTION — Better than 0.0002% full scale.
- WEIGHT — 3.5 ounces net.
- OUTPUT — $\pm 7\frac{1}{2}$ v dc and/or ± 1.5 ma full scale.
- EXCITATION — Plus 15 v dc, 5 ma max.; minus 15 v dc, 5 ma max.

SPECIFICATIONS	MODEL 4310	MODEL 4112	MODEL 4143	MODEL 4005
Non-Linearity Plus Hysteresis	0.05%	0.1% Full Scale		
Resolution	0.0002%	Better than 0.001%		
Reproducibility	0.1%	0.05%	0.1%	0.1%
Ranges	± 0.1 G to ± 30 G	± 0.1 G to ± 20.0 G	± 0.5 G to ± 10.0 G	± 0.1 G to ± 20.0 G
Output, max.	± 7.5 volts	± 15 volts	± 45 volts	± 35 volts
Excitation	Any ± 15 vdc unreg. supply	Model 4071 \$250.00	Model 4071S \$250.00	Model 4051 \$175.00
Magnetic Shielding	Yes	Yes	No	Yes
Net Weight	0.2 lbs.	1.3 lbs.	0.8 lbs.	1.6 lbs.
Price (fob factory)				

The Donner Model 4310 Precision Linear Servo Accelerometer is completely transistorized. A subminiature counterpart of standard Donner vacuum tube models, the Model 4310 delivers ± 7.5 volts output at 0.05% linearity or better. Output will drive a 0-1 ma recorder directly. Total input power requirement is ± 15 volts of unregulated dc power at milliwatt levels. Zero stability and linearity are enforced by the self-contained high gain servo system. MIL-USN silicon transistors allow operation from -40° C. to $+100^{\circ}$ C. The Model 4310 is recommended for measurement and control functions in airborne, vehicular, and ground based applications.

TEST INSTRUMENTS



MODEL 2102 WAVE ANALYZER

30 cps to 50kc coverage, 3% calibration accuracy. 160 μ v to 500 volts rms full scale sensitivity. Broad and narrow crystal filter selectivities. VTVM reads harmonic components directly in percent and db. Simple operation, portability, reliability.

Price rack or cabinet,



MODEL 5002 NULL VOLTMETER

Measures dc voltage by comparison with a precision internal standard. Range: -100 to $+100$ volts. Direct reading to 0.1% accuracy. Null detection sensitivity, 0.5 μ amp.

Price,



MODEL 2800 WOW AND FLUTTER METER

Accurately measures frequency modulation of an input signal, commonly known as "wow" or "flutter." Input frequency, 3000 cps $\pm 5\%$ or 1000 cps $\pm 5\%$. Average input level, at 3kc, 0.1 to 50 v rms, at 1 kc, 5 to 50 v rms. Pass bands, 0.5 to 10 cps, 10 to 300 cps, and 0.5 to 300 cps.

Price, cabinet; rack.

Donner engineering representatives are located throughout the free world. Your nearest representative will be happy to arrange a demonstration of any Donner equipment and provide you with further information, or write directly to

**DONNER SCIENTIFIC
COMPANY**

CONCORD, CALIFORNIA

Phone MULberry 2-6161 • Cable "DONNER"

